CLAIMS

What is claimed is:

5   1. A method for managing Internet Protocol (IP) addresses on a data communications

network, comprising:

allocating a plurality of local IP address pools, each of said local IP address pools

associated with a different network edge device capable of accepting connection

requests requiring an IP address, said network edge device having a local

10   memory, said local memory including a local IP address pool database;

requesting IP address usage data from one or more of said network edge devices;

receiving said requested IP address usage data;

determining whether one or more of said plurality of local IP address pools should be

reallocated based upon at least said requested IP address usage data;

15   reallocating one or more of said plurality of local IP address pools based upon said

determining; and

updating one or more of said local IP address pool databases and a global IP pool

database based upon said reallocating, said global IP address pool database

including the information maintained in each said local IP address pool.

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2. The method of claim 1 wherein

said local IP address pool includes a high watermark that indicates the maximum

number of IP addresses used by said network edge device;

said determining further comprises ascertaining whether said high watermark of a

local address pool exceeds a high watermark limit; and

said method further comprises indicating one or more IP address pools should be

5   reallocated to give more IP addresses to the network element associated with said

high watermark when said high watermark exceeds said high watermark limit.

3. The method of claim 2 wherein

each said local IP address pool further comprises a low watermark that indicates the

10   minimum number of IP addresses used by said network edge device;

said determining further comprises ascertaining whether said low watermark of said

address pool exceeds a low watermark limit; and

said method further comprises indicating one or more IP address pools should be

reallocated to reclaim IP addresses from the network element associated with

15   said low watermark when said low watermark exceeds said low watermark limit.

4. The method of claim 3 wherein said reallocating further comprises:

allocating an IP address from IP addresses reclaimed from other IP address pools

when said high watermark exceeds said high watermark limit and when the

20   number of unallocated IP addresses is insufficient;

allocating an IP addresses from unallocated IP addresses when said high watermark

exceeds said high watermark limit and when the number of unallocated IP

addresses is sufficient; and

reallocating one or more IP address pools to reclaim IP addresses from a local IP

address pool when said high watermark is less than said high watermark limit

and said low watermark is greater than said low watermark limit.

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5. The method of claim 1 wherein

each said local IP address pool further comprises a low watermark that indicates the

minimum number of IP addresses used by said network edge device;

said determining further comprises ascertaining whether said low watermark of said

10   address pool exceeds a low watermark limit; and

said method further comprises indicating one or more IP address pools should be

reallocated to reclaim IP addresses from the network element associated with

said low watermark when said low watermark exceeds said low watermark limit.

15   6. The method of claim 3 wherein

said low watermark is expressed as a percentage of allocated IP addresses; and

said high watermark is expressed as a percentage of allocated IP addresses.

7. The method of claim 6 wherein said network operates according to a simple network

20   management protocol (SNMP).

8. The method of claim 7 wherein

said low watermark is stored in an expression MIB; and

said high watermark is stored in an expression MIB.

9. A method for managing Internet Protocol (IP) addresses on a data communications

    network, comprising:

5   allocating a plurality of local IP address pools, each of said local IP address pools

            associated with a different network edge device capable of accepting connection

            requests requiring an IP address, said network edge device having a local

            memory, said local memory including a local IP address pool database;

        receiving a communication from said network edge device, said communication

10   including an IP address usage summary;

        determining whether one or more of said plurality of local IP address pools should be

            adjusted based upon said IP address usage summary; and

        adjusting one or more of said plurality of local IP address pools based upon said

            determining.

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10. The method of claim 9 wherein:

        said local IP address pool includes a high watermark that indicates the maximum

            number of IP addresses used by said network edge device;

        said determining further comprises ascertaining whether said high watermark of a

20   local address pool exceeds a high watermark limit; and

        said method further comprises indicating one or more IP address pools should be

            reallocated to give more IP addresses to the network element associated with said

            high watermark when said high watermark exceeds said high watermark limit.

11. The method of claim 10 wherein

each said local IP address pool further comprises a low watermark that indicates the

minimum number of IP addresses used by said network edge device;

5   said determining further comprises ascertaining whether said low watermark of a said

address pool exceeds a low watermark limit; and

said method further comprises indicating one or more IP address pools should be

reallocated to reclaim IP addresses from the network element associated with

said low watermark when said low watermark exceeds said low watermark limit.

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12. The method of claim 11 wherein said reallocating further comprises:

allocating an IP address from IP addresses reclaimed from other IP address pools

when said high watermark exceeds said high watermark limit and when the

number of unallocated IP addresses is insufficient;

15   allocating an IP addresses from unallocated IP addresses when said high watermark

exceeds said high watermark limit and when the number of unallocated IP

addresses is sufficient; and

reallocating one or more IP address pools to reclaim IP addresses from a local IP

address pool when said high watermark is less than said high watermark limit

20   and said low watermark is greater than said low watermark limit.

13. The method of claim 9 wherein

each said local IP address pool further comprises a low watermark that indicates the

minimum number of IP addresses used by said network edge device;

said determining further comprises ascertaining whether said low watermark of said

address pool exceeds a low watermark limit; and

said method further comprises indicating one or more IP address pools should be

5   reallocated to reclaim IP addresses from the network element associated with

said low watermark when said low watermark exceeds said low watermark limit.

14. The method of claim 11 wherein

said low watermark is expressed as a percentage of allocated IP addresses; and

10   said high watermark is expressed as a percentage of allocated IP addresses.

15. The method of claim 14 wherein said network operates according to a simple network

management protocol (SNMP).

15   16. The method of claim 15 wherein

said low watermark is stored in an expression MIB; and

said high watermark is stored in an expression MIB.

17. A method for managing Internet Protocol (IP) addresses on a data communications

20   network, comprising:

receiving a communication;

allocating an available IP address from said local IP address pool if said

communication includes a connection request, said local IP address pool

associated with a different network edge device capable of accepting connection

25   requests;

determining whether said local IP address pool should be adjusted;

sending a alarm message to an IP pool manager when said IP address pool should be

adjusted; and

5   storing an IP address allocation when said communication includes an IP address

allocation.

18. The method of claim 17 wherein

said local IP address pool includes a high watermark that indicates the maximum

10   number of IP addresses used by said network edge device; and

said determining further comprises:

ascertaining whether said high watermark of a local address pool exceeds a high

watermark limit; and

indicating one or more IP address pools should be reallocated to give more IP

15   addresses to said network edge device when said high watermark exceeds

said high watermark limit.

19. The method of claim 18 wherein

each said local IP address pool further comprises a low watermark that indicates the

20   minimum number of IP addresses used by said network edge device; and

said determining further comprises:

ascertaining whether said low watermark of said address pool exceeds a low

watermark limit; and

said method further comprises indicating one or more IP address pools should be

reallocated to reclaim IP addresses from said network edge device when said

low watermark exceeds said low watermark limit.

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20. The method of claim 19 wherein said reallocating further comprises:

allocating an IP address from IP addresses reclaimed from other IP address pools

when said high watermark exceeds said high watermark limit and when the

number of unallocated IP addresses is insufficient;

10   allocating an IP addresses from unallocated IP addresses when said high watermark

exceeds said high watermark limit and when the number of unallocated IP

addresses is sufficient; and

reallocating one or more IP address pools to reclaim IP addresses from said local IP

address pool when said high watermark is less than said high watermark limit

15   and said low watermark is greater than said low watermark limit.

21. The method of claim 17 wherein

each said local IP address pool further comprises a low watermark that indicates the

minimum number of IP addresses used by said network edge device; and

20   said determining further comprises:

ascertaining whether said low watermark of said local address pool exceeds a low

watermark limit; and

indicating one or more IP address pools should be reallocated to reclaim IP

addresses from the network element associated with said low watermark

when said low watermark exceeds said low watermark limit.

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22. The method of claim 19 wherein

said low watermark is expressed as a percentage of allocated IP addresses; and

said high watermark is expressed as a percentage of allocated IP addresses.

10   23. The method of claim 22 wherein said network operates according to a simple network

management protocol (SNMP).

24. The method of claim 23 wherein

said low watermark is stored in an expression MIB; and

15   said high watermark is stored in an expression MIB.

25. A program storage device readable by a machine, embodying a program of

instructions executable by the machine to perform a method to manage Internet

Protocol (IP) addresses on a data communications network, the method comprising:

20   allocating a plurality of local IP address pools, each of said local IP address pools

associated with a different network edge device capable of accepting connection

requests requiring an IP address, said network edge device having a local

memory, said local memory including a local IP address pool database;

requesting IP address usage data from one or more of said network edge devices;

25   receiving said requested IP address usage data;

determining whether one or more of said plurality of local IP address pools should be

reallocated based upon at least said requested IP address usage data;

reallocating one or more of said plurality of local IP address pools based upon said

5   determining; and

updating one or more of said local IP address pool databases and a global IP pool

database based upon said reallocating, said global IP address pool database

including the information maintained in each said local IP address pool.

10   26. The program storage device of claim 25 wherein

said local IP address pool includes a high watermark that indicates the maximum

number of IP addresses used by said network edge device;

said determining further comprises ascertaining whether said high watermark of a

local address pool exceeds a high watermark limit; and

15   said method further comprises indicating one or more IP address pools should be

reallocated to give more IP addresses to the network element associated with said

high watermark when said high watermark exceeds said high watermark limit.

27. The program storage device of claim 26 wherein

20   each said local IP address pool further comprises a low watermark that indicates the

minimum number of IP addresses used by said network edge device;

said determining further comprises ascertaining whether said low watermark of said

address pool exceeds a low watermark limit; and

said method further comprises indicating one or more IP address pools should be

reallocated to reclaim IP addresses from the network element associated with

said low watermark when said low watermark exceeds said low watermark limit.

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28. The program storage device of claim 27 wherein said reallocating further comprises:

allocating an IP address from IP addresses reclaimed from other IP address pools

when said high watermark exceeds said high watermark limit and when the

number of unallocated IP addresses is insufficient;

10   allocating an IP addresses from unallocated IP addresses when said high watermark

exceeds said high watermark limit and when the number of unallocated IP

addresses is sufficient; and

reallocating one or more IP address pools to reclaim IP addresses from a local IP

address pool when said high watermark is less than said high watermark limit

15   and said low watermark is greater than said low watermark limit.

29. The program storage device of claim 25 wherein

each said local IP address pool further comprises a low watermark that indicates the

minimum number of IP addresses used by said network edge device;

20   said determining further comprises ascertaining whether said low watermark of said

address pool exceeds a low watermark limit; and

said method further comprises indicating one or more IP address pools should be

reallocated to reclaim IP addresses from the network element associated with

said low watermark when said low watermark exceeds said low watermark limit.

30. The program storage device of claim 27 wherein

said low watermark is expressed as a percentage of allocated IP addresses; and

5   said high watermark is expressed as a percentage of allocated IP addresses.

31. The program storage device of claim 30 wherein said network operates according to a

simple network management protocol (SNMP).

10   32. The program storage device of claim 31 wherein

said low watermark is stored in an expression MIB; and

said high watermark is stored in an expression MIB.

33. A program storage device readable by a machine, embodying a program of

15   instructions executable by the machine to perform a method to manage Internet

Protocol (IP) addresses on a data communications network, the method comprising:

allocating a plurality of local IP address pools, each of said local IP address pools

associated with a different network edge device capable of accepting connection

requests requiring an IP address, said network edge device having a local

20   memory, said local memory including a local IP address pool database;

receiving a communication from said network edge device, said communication

including an IP address usage summary;

determining whether one or more of said plurality of local IP address pools should be

adjusted based upon said IP address usage summary; and

adjusting one or more of said plurality of local IP address pools based upon said

determining.

5   34. The program storage device of claim 33 wherein:

said local IP address pool includes a high watermark that indicates the maximum

number of IP addresses used by said network edge device;

said determining further comprises ascertaining whether said high watermark of a

local address pool exceeds a high watermark limit; and

10   said method further comprises indicating one or more IP address pools should be

reallocated to give more IP addresses to the network element associated with said

high watermark when said high watermark exceeds said high watermark limit.

35. The program storage device of claim 34 wherein

15   each said local IP address pool further comprises a low watermark that indicates the

minimum number of IP addresses used by said network edge device;

said determining further comprises ascertaining whether said low watermark of a said

address pool exceeds a low watermark limit; and

said method further comprises indicating one or more IP address pools should be

20   reallocated to reclaim IP addresses from the network element associated with

said low watermark when said low watermark exceeds said low watermark limit.

36. The program storage device of claim 35 wherein said reallocating further comprises:

allocating an IP address from IP addresses reclaimed from other IP address pools

when said high watermark exceeds said high watermark limit and when the

number of unallocated IP addresses is insufficient;

allocating an IP addresses from unallocated IP addresses when said high watermark

exceeds said high watermark limit and when the number of unallocated IP

addresses is sufficient; and

reallocating one or more IP address pools to reclaim IP addresses from a local IP

address pool when said high watermark is less than said high watermark limit

and said low watermark is greater than said low watermark limit.

37. The program storage device of claim 33 wherein

each said local IP address pool further comprises a low watermark that indicates the

minimum number of IP addresses used by said network edge device;

said determining further comprises ascertaining whether said low watermark of said

address pool exceeds a low watermark limit; and

said method further comprises indicating one or more IP address pools should be

reallocated to reclaim IP addresses from the network element associated with

said low watermark when said low watermark exceeds said low watermark limit.

38. The program storage device of claim 35 wherein

said low watermark is expressed as a percentage of allocated IP addresses; and

said high watermark is expressed as a percentage of allocated IP addresses.

39. The program storage device of claim 38 wherein said network operates according to a

    simple network management protocol (SNMP).

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40. The program storage device of claim 39 wherein

    said low watermark is stored in an expression MIB; and

    said high watermark is stored in an expression MIB.

10   41. A program storage device readable by a machine, embodying a program of

     instructions executable by the machine to perform a method to manage Internet

     Protocol (IP) addresses on a data communications network, the method comprising:

     receiving a communication;

     allocating an available IP address from said local IP address pool if said

15   communication includes a connection request, said local IP address pool

             associated with a different network edge device capable of accepting connection

             requests;

     determining whether said local IP address pool should be adjusted;

     sending a alarm message to an IP pool manager when said IP address pool should be

20   adjusted; and

     storing an IP address allocation when said communication includes an IP address

     allocation.

42. The program storage device of claim 41 wherein

   said local IP address pool includes a high watermark that indicates the maximum

   number of IP addresses used by said network edge device; and

5   said determining further comprises:

      ascertaining whether said high watermark of a local address pool exceeds a high

      watermark limit; and

      indicating one or more IP address pools should be reallocated to give more IP

      addresses to said network edge device when said high watermark exceeds

10   said high watermark limit.

43. The program storage device of claim 42 wherein

   each said local IP address pool further comprises a low watermark that indicates the

   minimum number of IP addresses used by said network edge device; and

15   said determining further comprises:

      ascertaining whether said low watermark of said address pool exceeds a low

      watermark limit; and

      said method further comprises indicating one or more IP address pools should be

      reallocated to reclaim IP addresses from said network edge device when said

20   low watermark exceeds said low watermark limit.

44. The program storage device of claim 43 wherein said reallocating further comprises:

allocating an IP address from IP addresses reclaimed from other IP address pools

when said high watermark exceeds said high watermark limit and when the

5   number of unallocated IP addresses is insufficient;

allocating an IP addresses from unallocated IP addresses when said high watermark

exceeds said high watermark limit and when the number of unallocated IP

addresses is sufficient; and

reallocating one or more IP address pools to reclaim IP addresses from said local IP

10   address pool when said high watermark is less than said high watermark limit

and said low watermark is greater than said low watermark limit.

45. The program storage device of claim 41 wherein

each said local IP address pool further comprises a low watermark that indicates the

15   minimum number of IP addresses used by said network edge device; and

said determining further comprises:

ascertaining whether said low watermark of said local address pool exceeds a low

watermark limit; and

indicating one or more IP address pools should be reallocated to reclaim IP

20   addresses from the network element associated with said low watermark

when said low watermark exceeds said low watermark limit.

46. The program storage device of claim 43 wherein

said low watermark is expressed as a percentage of allocated IP addresses; and

said high watermark is expressed as a percentage of allocated IP addresses.

47. The program storage device of claim 46 wherein said network operates according to a

5   simple network management protocol (SNMP).

48. The program storage device of claim 47 wherein

said low watermark is stored in an expression MIB; and

said high watermark is stored in an expression MIB.

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49. An apparatus for managing Internet Protocol (IP) addresses on a data

communications network, the apparatus comprising:

means for allocating a plurality of local IP address pools, each of said local IP address

pools associated with a different network edge device capable of accepting

15   connection requests requiring an IP address, said network edge device having a

local memory, said local memory including a local IP address pool database;

means for requesting IP address usage data from one or more of said network edge

devices;

means for receiving said requested IP address usage data;

20   means for determining whether one or more of said plurality of local IP address pools

should be reallocated based upon at least said requested IP address usage data;

means for reallocating one or more of said plurality of local IP address pools based

upon said determining; and

means for updating one or more of said local IP address pool databases and a global

IP pool database based upon said reallocating, said global IP address pool

database including the information maintained in each said local IP address pool.

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50. The apparatus of claim 49 wherein

said local IP address pool includes a high watermark that indicates the maximum

number of IP addresses used by said network edge device;

said means for determining further comprises means for ascertaining whether said

10   high watermark of a local address pool exceeds a high watermark limit; and

said apparatus further comprises means for indicating one or more IP address pools

should be reallocated to give more IP addresses to the network element

associated with said high watermark when said high watermark exceeds said high

watermark limit.

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51. The apparatus of claim 50 wherein

each said local IP address pool further comprises a low watermark that indicates the

minimum number of IP addresses used by said network edge device;

said means for determining further comprises means for ascertaining whether said

20   low watermark of said address pool exceeds a low watermark limit; and

said apparatus further comprises means for indicating one or more IP address pools

should be reallocated to reclaim IP addresses from the network element

associated with said low watermark when said low watermark exceeds said low

watermark limit.

52. The apparatus of claim 51 wherein said reallocating further comprises:

means for allocating an IP address from IP addresses reclaimed from other IP address

5   pools when said high watermark exceeds said high watermark limit and when the

number of unallocated IP addresses is insufficient;

means for allocating an IP addresses from unallocated IP addresses when said high

watermark exceeds said high watermark limit and when the number of

unallocated IP addresses is sufficient; and

10   means for reallocating one or more IP address pools to reclaim IP addresses from a

local IP address pool when said high watermark is less than said high watermark

limit and said low watermark is greater than said low watermark limit.

53. The apparatus of claim 49 wherein

15   each said local IP address pool further comprises a low watermark that indicates the

minimum number of IP addresses used by said network edge device;

said means for determining further comprises ascertaining whether said low

watermark of said address pool exceeds a low watermark limit; and

said apparatus further comprises means for indicating one or more IP address pools

20   should be reallocated to reclaim IP addresses from the network element

associated with said low watermark when said low watermark exceeds said low

watermark limit.

54. The apparatus of claim 51 wherein

said low watermark is expressed as a percentage of allocated IP addresses; and

said high watermark is expressed as a percentage of allocated IP addresses.

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55. The apparatus of claim 54 wherein said network operates according to a simple

network management protocol (SNMP).

56. The apparatus of claim 55 wherein

10   said low watermark is stored in an expression MIB; and

said high watermark is stored in an expression MIB.

57. An apparatus for managing Internet Protocol (IP) addresses on a data

communications network, the apparatus comprising:

15   means for allocating a plurality of local IP address pools, each of said local IP address

pools associated with a different network edge device capable of accepting

connection requests requiring an IP address, said network edge device having a

local memory, said local memory including a local IP address pool database;

means for receiving a communication from said network edge device, said

20   communication including an IP address usage summary;

means for determining whether one or more of said plurality of local IP address pools

should be adjusted based upon said IP address usage summary; and

means for adjusting one or more of said plurality of local IP address pools based upon

said determining.

58. The apparatus of claim 57 wherein:

    said local IP address pool includes a high watermark that indicates the maximum

5   number of IP addresses used by said network edge device;

    said means for determining further comprises means for ascertaining whether said

        high watermark of a local address pool exceeds a high watermark limit; and

    said apparatus further comprises means for indicating one or more IP address pools

        should be reallocated to give more IP addresses to the network element

10   associated with said high watermark when said high watermark exceeds said high

        watermark limit.

59. The apparatus of claim 10 wherein

    each said local IP address pool further comprises a low watermark that indicates the

15   minimum number of IP addresses used by said network edge device;

    said means for determining further comprises means for ascertaining whether said

        low watermark of a said address pool exceeds a low watermark limit; and

    said apparatus further comprises means for indicating one or more IP address pools

        should be reallocated to reclaim IP addresses from the network element

20   associated with said low watermark when said low watermark exceeds said low

        watermark limit.

60. The apparatus of claim 11 wherein said reallocating further comprises:

means for allocating an IP address from IP addresses reclaimed from other IP address

pools when said high watermark exceeds said high watermark limit and when the

number of unallocated IP addresses is insufficient;

means for allocating an IP addresses from unallocated IP addresses when said high

watermark exceeds said high watermark limit and when the number of

unallocated IP addresses is sufficient; and

means for reallocating one or more IP address pools to reclaim IP addresses from a

local IP address pool when said high watermark is less than said high watermark

limit and said low watermark is greater than said low watermark limit.

61. The apparatus of claim 57 wherein

each said local IP address pool further comprises a low watermark that indicates the

minimum number of IP addresses used by said network edge device;

said means for determining further comprises means for ascertaining whether said

low watermark of said address pool exceeds a low watermark limit; and

said apparatus further comprises means for indicating one or more IP address pools

should be reallocated to reclaim IP addresses from the network element

associated with said low watermark when said low watermark exceeds said low

watermark limit.

62. The apparatus of claim 59 wherein

said low watermark is expressed as a percentage of allocated IP addresses; and

said high watermark is expressed as a percentage of allocated IP addresses.

63. The apparatus of claim 62 wherein said network operates according to a simple

5   network management protocol (SNMP).

64. The apparatus of claim 63 wherein

said low watermark is stored in an expression MIB; and

said high watermark is stored in an expression MIB.

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65. An apparatus for managing Internet Protocol (IP) addresses on a data

communications network, the apparatus comprising:

means for receiving a communication;

means for allocating an available IP address from a local IP address pool if said

15   communication includes a connection request, said local IP address pool

associated with a different network edge device capable of accepting connection

requests;

means for determining whether said local IP address pool should be adjusted;

means for sending a alarm message to a global IP pool manager when said IP address

20   pool should be adjusted; and

means for storing an IP address allocation when said communication includes an IP

address allocation.

66. The apparatus of claim 65 wherein

    said local IP address pool includes a high watermark that indicates the maximum

    number of IP addresses used by said network edge device; and

5   said means for determining further comprises:

    means for ascertaining whether said high watermark of a local address pool

    exceeds a high watermark limit; and

    means for indicating one or more IP address pools should be reallocated to give

    more IP addresses to said network edge device when said high watermark

10   exceeds said high watermark limit.

67. The apparatus of claim 66 wherein

    each said local IP address pool further comprises a low watermark that indicates the

    minimum number of IP addresses used by said network edge device; and

15   said means for determining further comprises:

    means for ascertaining whether said low watermark of said address pool exceeds a

    low watermark limit; and

    said apparatus further comprises means for indicating one or more IP address

    pools should be reallocated to reclaim IP addresses from said network edge

20   device when said low watermark exceeds said low watermark limit.

68. The apparatus of claim 67 wherein said reallocating further comprises:

means for allocating an IP address from IP addresses reclaimed from other IP address pools when said high watermark exceeds said high watermark limit and when the number of unallocated IP addresses is insufficient;

means for allocating an IP addresses from unallocated IP addresses when said high watermark exceeds said high watermark limit and when the number of unallocated IP addresses is sufficient; and

means for reallocating one or more IP address pools to reclaim IP addresses from said local IP address pool when said high watermark is less than said high watermark limit and said low watermark is greater than said low watermark limit.

69. The apparatus of claim 65 wherein

each said local IP address pool further comprises a low watermark that indicates the minimum number of IP addresses used by said network edge device; and

said means for determining further comprises:

means for ascertaining whether said low watermark of said local address pool exceeds a low watermark limit; and

means for indicating one or more IP address pools should be reallocated to reclaim IP addresses from the network element associated with said low watermark when said low watermark exceeds said low watermark limit.

70. The apparatus of claim 67 wherein

said low watermark is expressed as a percentage of allocated IP addresses; and

said high watermark is expressed as a percentage of allocated IP addresses.

71. The apparatus of claim 70 wherein said network operates according to a simple

5   network management protocol (SNMP).

72. The apparatus of claim 71 wherein

        said low watermark is stored in an expression MIB; and

        said high watermark is stored in an expression MIB.

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73. An apparatus capable of managing Internet Protocol (IP) addresses on a data

        communications network, said apparatus comprising:

        a memory for storing a global IP address pool; and

        a global IP pool manager, comprising:

15   an allocator capable of allocating a plurality of local IP address pools, each of said

                 local IP address pools associated with a different network edge device

                 capable of accepting connection requests requiring an IP address;

                 a requestor capable of requesting IP address usage data from one or more of said

                 network edge devices;

20   a determiner capable of determining whether one or more of said plurality of local

                 IP address pools should be reallocated based upon at least said requested IP

                 address usage data;

                 a reallocator capable of reallocating one or more of said plurality of local IP

                 address pools based upon said an indication from said determiner; and

an updater capable of updating one or more of said local IP address pool

databases and said global IP pool database based upon said reallocating.

5   74. The apparatus of claim 73 wherein

said local IP address pool includes a high watermark that indicates the maximum

number of IP addresses used by said network edge device; and

said determiner is further configured to ascertain whether said high watermark of a

local address pool exceeds a high watermark limit and to indicate IP address pool

10   should be reallocated to give more IP addresses to the network element

associated with said high watermark when said high watermark exceeds said high

watermark limit.

75. The apparatus of claim 74 wherein

15   each said local IP address pool further comprises a low watermark that indicates the

minimum number of IP addresses used by said network edge device; and

said determiner is further configured to ascertain whether said low watermark of said

address pool exceeds a low watermark limit and to indicate one or more IP

address pools should be reallocated to reclaim IP addresses from the network

20   element associated with said low watermark when said low watermark exceeds

said low watermark limit.

76. The apparatus of claim 75 wherein said reallocator further configured to:

allocate an IP address from IP addresses reclaimed from other IP address pools when said high watermark exceeds said high watermark limit and when the number of

5   unallocated IP addresses is insufficient;

allocate an IP addresses from unallocated IP addresses when said high watermark exceeds said high watermark limit and when the number of unallocated IP addresses is sufficient; and

reallocate one or more IP address pools to reclaim IP addresses from a local IP

10   address pool when said high watermark is less than said high watermark limit and said low watermark is greater than said low watermark limit.

77. The apparatus of claim 73 wherein

each said local IP address pool further comprises a low watermark that indicates the

15   minimum number of IP addresses used by said network edge device; and

said determiner is further configured to ascertain whether said low watermark of said address pool exceeds a low watermark limit and to indicate one or more IP address pools should be reallocated to reclaim IP addresses from the network element associated with said low watermark when said low watermark exceeds

20   said low watermark limit.

78. The apparatus of claim 75 wherein

said low watermark is expressed as a percentage of allocated IP addresses; and

said high watermark is expressed as a percentage of allocated IP addresses.

79. The apparatus of claim 78 wherein said network operates according to a simple

network management protocol (SNMP).

5

80. The apparatus of claim 79 wherein

said low watermark is stored in an expression MIB; and

said high watermark is stored in an expression MIB.

10   81. An apparatus capable of managing Internet Protocol (IP) addresses on a data

communications network, said apparatus comprising:

a memory for storing a global IP address pool; and

a global IP pool manager, comprising:

an allocator capable of allocating a plurality of local IP address pools, each of said

15   local IP address pools associated with a different network edge device

capable of accepting connection requests requiring an IP address;

a receiving interface capable of receiving a communication from said network

edge device, said communication including an IP address usage summary;

a determiner capable of determining whether one or more of said plurality of local

20   IP address pools should be reallocated based upon said IP address usage data;

a reallocator capable of reallocating one or more of said plurality of local IP

address pools based upon said an indication from said determiner; and

an updater capable of updating one or more of said local IP address pool

databases and said global IP pool database based upon said reallocating.

82. The apparatus of claim 81 wherein:

said local IP address pool includes a high watermark that indicates the maximum

5   number of IP addresses used by said network edge device; and

said determiner is further configured to ascertain whether said high watermark of a

local address pool exceeds a high watermark limit and to indicate one or more IP

address pools should be reallocated to give more IP addresses to the network

element associated with said high watermark when said high watermark exceeds

10   said high watermark limit.

83. The apparatus of claim 82 wherein

each said local IP address pool further comprises a low watermark that indicates the

minimum number of IP addresses used by said network edge device; and

15   said determiner is further configured to ascertain whether said low watermark of a

said address pool exceeds a low watermark limit and to indicate one or more IP

address pools should be reallocated to reclaim IP addresses from the network

element associated with said low watermark when said low watermark exceeds

said low watermark limit.

20

84. The apparatus of claim 83 wherein said reallocator is further configured to:

allocate an IP address from IP addresses reclaimed from other IP address pools when

said high watermark exceeds said high watermark limit and when the number of

unallocated IP addresses is insufficient;

allocate an IP addresses from unallocated IP addresses when said high watermark

exceeds said high watermark limit and when the number of unallocated IP

addresses is sufficient; and

5   reallocate one or more IP address pools to reclaim IP addresses from a local IP

address pool when said high watermark is less than said high watermark limit

and said low watermark is greater than said low watermark limit.

85. The apparatus of claim 81 wherein

10   each said local IP address pool further comprises a low watermark that indicates the

minimum number of IP addresses used by said network edge device; and

said determiner is further configured to ascertain whether said low watermark of said

address pool exceeds a low watermark limit and to indicate one or more IP

address pools should be reallocated to reclaim IP addresses from the network

15   element associated with said low watermark when said low watermark exceeds

said low watermark limit.

86. The apparatus of claim 83 wherein

said low watermark is expressed as a percentage of allocated IP addresses; and

20   said high watermark is expressed as a percentage of allocated IP addresses.

87. The apparatus of claim 86 wherein said network operates according to a simple

network management protocol (SNMP).

88. The apparatus of claim 84 wherein

said low watermark is stored in an expression MIB; and

said high watermark is stored in an expression MIB.

5

89. An apparatus capable of managing Internet Protocol (IP) addresses on a data

communications network, said apparatus comprising:

a receiver capable of receiving a communication;

an allocator capable of allocating an available IP address from a local IP address pool

10   if said communication includes a connection request, said local IP address pool

associated with a different network edge device capable of accepting connection

requests;

a determiner capable of determining whether said local IP address pool should be

adjusted;

15   an notifier capable of sending a alarm message to a global IP pool manager when said

IP address pool should be adjusted; and

a memory capable of storing an IP address allocation when said communication

includes an IP address allocation.

20   90. The apparatus of claim 89 wherein

said local IP address pool includes a high watermark that indicates the maximum

number of IP addresses used by said network edge device; and

said determiner is further configured to ascertain whether said high watermark of a

local address pool exceeds a high watermark limit and to indicate one or more IP

address pools should be reallocated to give more IP addresses to said network

edge device when said high watermark exceeds said high watermark limit.

5   91. The apparatus of claim 90 wherein

each said local IP address pool further comprises a low watermark that indicates the

minimum number of IP addresses used by said network edge device; and

said determiner is further configured to ascertain whether said low watermark of said

address pool exceeds a low watermark limit and to indicate one or more IP

10   address pools should be reallocated to reclaim IP addresses from said network

edge device when said low watermark exceeds said low watermark limit.

92. The apparatus of claim 91 wherein said reallocator is further configured to:

allocate an IP address from IP addresses reclaimed from other IP address pools when

15   said high watermark exceeds said high watermark limit and when the number of

unallocated IP addresses is insufficient;

allocate an IP addresses from unallocated IP addresses when said high watermark

exceeds said high watermark limit and when the number of unallocated IP

addresses is sufficient; and

20   reallocate one or more IP address pools to reclaim IP addresses from said local IP

address pool when said high watermark is less than said high watermark limit

and said low watermark is greater than said low watermark limit.

93. The apparatus of claim 89 wherein

    each said local IP address pool further comprises a low watermark that indicates the

    minimum number of IP addresses used by said network edge device; and

5   said determiner is further configured to ascertain whether said low watermark of said

    local address pool exceeds a low watermark limit and to indicate one or more IP

    address pools should be reallocated to reclaim IP addresses from the network

    element associated with said low watermark when said low watermark exceeds

    said low watermark limit.

10

94. The apparatus of claim 91 wherein

    said low watermark is expressed as a percentage of allocated IP addresses; and

    said high watermark is expressed as a percentage of allocated IP addresses.

15 95. The apparatus of claim 94 wherein said network operates according to a simple

    network management protocol (SNMP).

96. The apparatus of claim 95 wherein

    said low watermark is stored in an expression MIB; and

20 said high watermark is stored in an expression MIB.